

UNITED STATES PATENT APPLICATION

of

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for

APPARATUS AND METHOD FOR MULTICHANNEL SOUND
REPRODUCTION SYSTEM

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APPARATUS AND METHOD FOR MULTICHANNEL SOUND REPRODUCTION SYSTEM

5 BACKGROUND OF THE INVENTION

The invention relates to an audio system, and in particular to an audio system and method that includes an FM receiver that provides an audio signal and a reception signal to a multichannel sound production system. The multichannel sound production system provides a plurality of speaker output signals encoded in response to the reception signal.

10 FM stereo receivers are often equipped with a control unit that controls the stereo and mono components within its audio output signal in response to the reception quality. The term used in this regard is "channel separation" which is especially suitable for use in FM stereo receivers in vehicles, since the reception quality for stereo reception is often not sufficient due to the conditions under which the vehicle is driven at any given time. For this reason, the stereo component in the reproduced signal is reduced when reception conditions worsen, while the mono component is simultaneously increased. This shift from stereo to mono during poor reception conditions may reach the point of complete mono reproduction.

20 A multichannel sound reproduction system with a plurality of speakers may be connected to this type of FM stereo receiver. The reproduction system generates a plurality of reproduction signals for a plurality of speakers to improve the spatial acoustic pattern from the audio output signal supplied by the FM stereo receiver. However, when the stereo component in the audio output signal from the FM stereo receiver decreases, while the mono component is increases, the perceived audio quality of the spatial acoustic pattern of the multichannel reproduction decreases – with the ultimate result often being a complete breakdown of the spatial acoustic pattern. As a result, strong
25 fluctuations in reception quality during mobile operation result in an unacceptable drift in the

acoustic pattern.

Therefore, there is a need to improve the acoustic pattern for a multichannel reproduction system connected to an FM stereo receiver, in response to a degrading stereo signal, and to reduce/prevent the drift in the acoustic pattern under conditions of fluctuating reception quality.

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SUMMARY OF THE INVENTION

Briefly, according to an aspect of the invention, an audio system includes an FM receiver that provides an audio output signal to a multichannel sound reproduction system. The FM receiver also provides a control signal indicative of the reception quality of the audio signal. The multichannel sound reproduction system provides a plurality of speaker output signals indicative of the audio output signal, wherein the spatial pattern associated with the plurality of speaker output signals is set in response to the control signal.

The audio system monitors reception quality, and sets its output signals accordingly to improve the acoustic pattern for a multichannel reproduction system connected to an FM stereo receiver, in response to a degrading stereo signal, and to prevent the drift in the acoustic pattern under conditions of fluctuating reception quality.

The control signal is indicative of reception quality (e.g., the reception field strength or the reception level of the FM stereo receiver). The control signal controls the sound reproduction of the multichannel sound reproduction system.

In one embodiment, the FM receiver provides the control signal, which also controls the stereo and mono components within its audio output signal. Significantly, in this embodiment no

additional control signal is required to control the multichannel sound reproduction system, since the control signal within the FM receiver used to control the stereo and mono components is indicative of the reception quality.

In an alternative embodiment, the control signal for controlling the multichannel sound reproduction system may be derived from one of the numerous quality signals generated by the tuner of the FM stereo receiver.

In yet another embodiment the sound reproduction of the multichannel sound reproduction system can be controlled in response to the stereo component within the audio output signal from the FM stereo receiver.

These and other objects, features and advantages of the present invention will become more apparent in light of the following detailed description of preferred embodiments thereof, as illustrated in the accompanying drawings.

DETAILED DESCRIPTION OF THE INVENTION

The FIGURE is block diagram illustration of an audio system 10 that includes an FM receiver 12 and a multichannel sound reproduction system 14. The receiver 12 receives a signal on a line 16 (e.g., from an antenna), and provides an audio output signal on a line 18 to the multichannel sound reproduction system 14. The FM receiver 12 also provides a control signal on a line 20, indicative of the reception quality of the audio output signal on the line 18.

The multichannel sound reproduction system 14 provides a plurality of speaker output signals on lines 24-29 to a plurality of speakers 30-35 respectively. The multichannel sound

reproduction system controls the spatial pattern of the speaker output signals in response to the control signal on the line 20. For example, when the stereo component in the output signal of the FM stereo receiver 12 falls below a specified threshold value in the multichannel sound reproduction system, stereo reproduction may occur.

5 In place of stereo reproduction, pseudo-stereo reproduction or mono reproduction may be produced in the multichannel sound reproduction system. In the event the stereo component in the output signal of the FM stereo receiver falls below a first specified threshold value, it is especially advantageous to provide for stereo reproduction. When the stereo component in the output signal of the FM stereo receiver falls further to a level below a second specified threshold value, the multichannel sound reproduction system switches to pseudo-stereo reproduction. Similarly, if the stereo component in the output signal of the FM stereo receiver 14 falls below a third specified threshold value, the multichannel sound reproduction system switches over from pseudo-stereo reproduction to mono reproduction. As the stereo component in the output signal of the FM stereo receiver increases, the system in turn switches back to pseudo-stereo or stereo reproduction in accordance with the specified threshold values.

The control signal on the line 20 may, for example, be the control signal generated in the FM stereo receiver FM to control the stereo and mono components within the output signal on the line 18. Alternatively, the control signal on the line 20, may be derived from one of the numerous quality signals from the tuner of the FM stereo receiver 12.

20 The technique of the present invention is especially well suited for use in motor vehicles since the receiver constantly encounters fluctuating reception conditions. However, the technique

of the present may of course also be used in fixed multichannel sound reproduction systems, since the reception quality may drop below critical values for fixed systems as well (e.g., as a result of weather phenomena or due to defective transmitters which transmit only at low field strength).

Although the present invention has been shown and described with respect to several
5 preferred embodiments thereof, various changes, omissions and additions to the form and detail thereof, may be made therein, without departing from the spirit and scope of the invention.

What is claimed is:

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